Status of the HE-Linac project at GSI

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UNILAC Upgrade

The High-Energy (HE) Linac project is defined by the substitution of the existing post-stripper (Alvarez) section of the UNILAC. The substition of the existing Alvarez section is one of the major steps towards an adequate FAIR injector linac. Nevertheless the whole accelerator chain has to be taken into account. Starting from the ion sources to the SIS18 transfer channel every section is re-investigated for improvements in beam quality and intensity. Workpackages are defined together with the Institute of Applied Physics (IAP) at Frankfurt University [1]:

- 3rd ion source terminal and Compact-LEBT [2]
- HSI RFQ
- alternative MEBT design
  for an improved beam matching to the HSI IH [3]
- pulsed gas stripper [4] and Emtex [5]

Alvarez DTL and IH DTL

Concerning the post-stripper section itself, two concepts are discussed: On the one hand the substitution of the existing Alvarez structure by six IH cavities [6], on the other hand the substitution by redesigned and new Alvarez tanks. Regarding the design comprising six IH cavities efforts were made to develop a recipe for finding an optimum parameter setting in daily operation. Such a recipe was not found per se, but the design was optimized, which results in an improvement of transmission through the post-stripper section from 88% to 92%. The beam brilliance behind the post-stripper increased by a factor of 1.5 simultaneously [7]. The transmission is limited by the assumed longitudinal beam particle input distribution. It was set to 20 keV/u·ns for comparison reasons. Activities at GSI focus on the substitution of the post-stripper by an Alvarez section. Nevertheless within the IAP-GSI-collaboration the substitution of the post-stripper by six IH-tanks is followed. At the end of the designing phase both concepts are planned to be presented to an external review committee for receiving a qualified recommendation. Both concepts are compatible to the modernisation of the 108 MHz RF systems of the UNILAC post stripper section [8].

Designing phase

Concerning the Alvarez DTL option investigations about optimizing the rf design have started aiming at improvement of the accelerating field properties and increase of the shunt impedance. First results are promising. Optimising the driftube geometry, especially smoothening the drifttube's cap, lower the surface peak fields. The shunt impedance could be increased by 10 percent. Another task is initiated through discussions with the colleagues, who designed the LINAC4 at CERN. At LINAC4 post-couplers are applied to reduce field instabilities. The function of post-couplers are covered by the two stem suspension of the drifttubes, which is applied at GSI. The angle between the stems as well as the stem configuration of group of drifttubes is playing a key role [9]. All this rf design studies will be complemented by measurements. For that purpose an aluminium rf model (scale 1:3) is ordered. In a start version a ten gap model is planned. It is designed for testing different drifttube shapes and confirming the calculated predictions w.r.t. the stem configuration [10]. Focusing on the optimization of the rf-properties the installation space of the quadrupole, which is usually integrated in the drifttube, is an important issue. Theoretical studies and corresponding measurements at the GSI UNILAC provide evidence of space charge driven resonant emittance coupling in high current operation [11]. The operation at these resonances, which leads to an emittance growth, could be avoided by setting an adequate transverse phase advance. An adequate phase advance can be set if the quadrupoles for the new design are specified to reach 20% higher gradients than the existing. First studies for high gradients quadrupoles, which fit into the smaller installation space of the new drifttube geometry, are done [12].

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